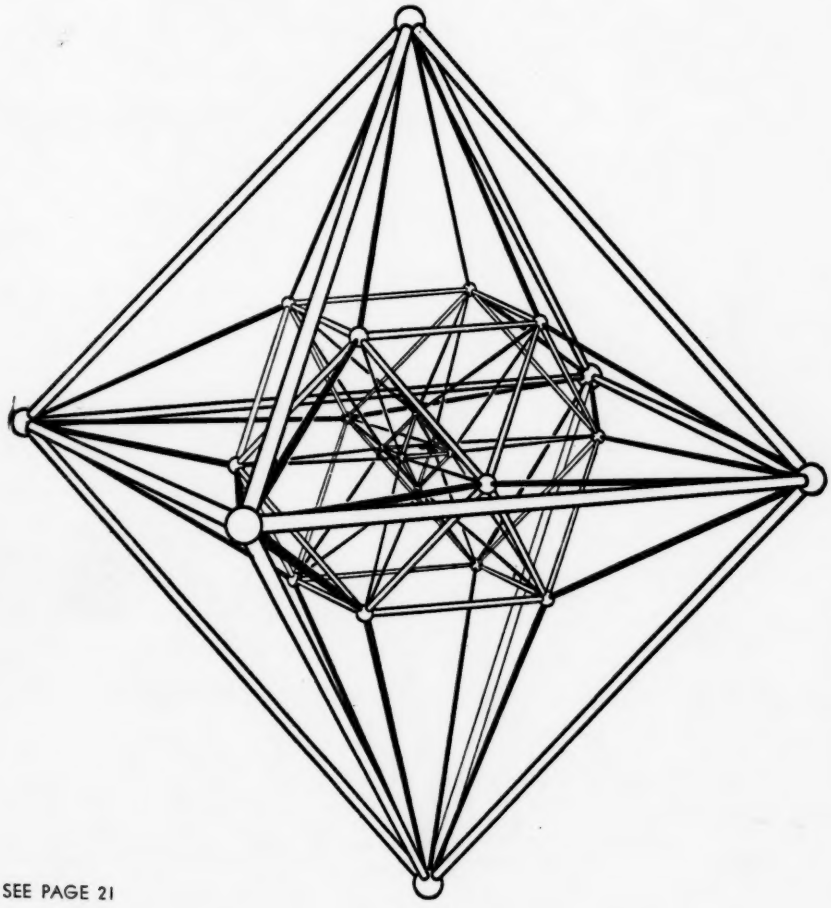
MAIN CURRENTS

IN MODERN THOUGHT



SEE PAGE 21

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MAIN CURRENTS IN MODERN THOUGHT

A co-operative journal to promote the free association of those working toward the integration of all knowledge through the study of the whole of things, Nature, Man, and Society, assuming the universe to be one, dependable, intelligible, harmonious.

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"Ah, but a man's reach should exceed his grasp, or what's a heaven for?" — BROWNING

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CONTENTS

General

AIMS OF THE FOUNDATION FOR INTEGRATED EDUCATION

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The corporate statement of Aims declares that the Foundation has been established:

1. To collect, create, and distribute authoritative materials which will encourage the development of unified overall concepts in education; to improve the balance of relationships between the physical sciences and the social sciences; to inquire into the phenomena of purposive activity in nature, man and the universe.

2. To assist teachers to understand and use such materials, and to develop an active, realistic, comprehensive philosophy which will communicate to their students the unity, coherence, and beauty of the world in which we live.

3. To remedy, solely by such educative measures, the conceptual and hence the ethical, social, economic, and political breakdown of our times, looking to a peaceful world order.

The members, associates, and staff of the Foundation realize that the progressive discovery of unifying over-all concepts concerning man and the universe is not a task to be performed successfully in isolation from the historical, social, economic, and political context of our times, nor in terms of application less than global.

The work of the Foundation is wholly educational, yet is referred constantly to the contemporary scene in all its aspects, no less than to the total available wealth of human experience and knowledge.

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TODAY'S REQUIREMENTS IN EDUCATION*

Robert Ulich

Harvard University

The Need for Harmony Between Methods Of Inductive Science and Deductive Humanities

My task this morning is to talk about the role of education in bringing about some harmony between the primarily empirical and inductive method of the natural sciences on the one hand, and the more intuitive and deductive methods of the humanities on the other.

I shall address myself to this problem in three ways. First, I shall speak of the historical, next, of the philosophic-systematic aspects, and third, of the practical implications.

I. *The Historical Aspect*

Until the 16th and 17th centuries education was conceived of more or less deductively. In the Middle Ages, even during the Renaissance, man was presumed to live under divine dispensation in accordance with which he had to fulfill his purpose. Education was designed to fit him for that role. Truly, even in the period of scholasticism men such as Hugh of Saint Victor, one of the well known philosophers, and John Gerson, chancellor of the University of Paris, had a profound insight into the nature of man. But this was more the result of loving empathy and practical educational experience than of scientific inquiry. Not earlier than in the 17th century the inductive joined the deductive method. The Moravian bishop, John Amos Comenius, influenced by Francis Bacon, combined religious mysticism with systematic interest in the nature of learning. Almost all the outstanding thinkers of that period, deeply concerned as they were with the problem of reality, doubted the validity of the older deductive method. In all their works we find a chapter on "method" (a Greek word which means "going along the right path"), which path could lead the human mind toward understanding the world in its essence.

Comenius was almost forgotten in the 18th century. The enlightened philosophers ridiculed his mysticism, but forgot his empiricism. The next step was made by the great Swiss educator, Pestalozzi (1746-1827), who, from my point of view, has said almost everything that is important in education. Also in Pestalozzi we perceive the deep desire to connect the educational process with inductive insight into the working of the mind, but he is less optimistic and naive than were the 17th century's believers in "method." Whereas Comenius and Bacon hoped that with proper understanding of the mechanics of learning individual differences of talent would disappear — everybody being capable of the same intellectual achievement as his fellowmen — Pestalozzi knew about the importance of such differences, despite his profoundly religious faith in the sameness of human nature. However, as in Comenius, there was still a strongly deductive, even mystical streak in Pestalozzi.

The first man who from our modern point of view inquired systematically into the process of learning and education was the successor of Kant at the philosophical chair of Koenigsberg, Johann Friedrich Herbart (1776-1841). Every modern educator and psychologist, whether he knows it or not, is deeply indebted to him.

In the United States of today John Dewey's pragmatism and Edward Thorndike's psychology have emphasized the inductive approach to education, and in our institutions for the training of teachers psychology, sociology, methods of teaching, and statistics absorb probably considerably more time than humanistic and philosophical studies. So much for the historical view.

II. *The Philosophical Aspect*

When we ask to what degree the invasion of the inductive approach has really influenced education as a whole, we arrive at a somewhat ambiguous solution. Almost every educational textbook states that Comenius was a "sense perceptionalist." In other words, he stressed the value of connecting the concepts to be taught with concrete and visible materials. But, as already indicated, in terms of Weltanschauung he was a pietist mystic. There was no connection between his inductive method and his basic philosophy of life. Pestalozzi was a Christian, though undogmatic, humanitarian, not at all "scientific" in the modern sense of the word.

* A talk given at the 1953 Workshop of the Foundation for Integrated Education, co-sponsored by The University of Maine, Orono.

Herbart was influenced to some degree by Locke and Hume and most definitely by Kant; he was critical of the deductive method and one of the first, if not the first, to recommend the use of mathematics for psychology. Yet, when he speaks of the aims of education, he reveals himself as a secularized Christian, embodying the principles of humanist idealism.

If we examine closely the much disputed pragmatic philosophy of John Dewey, we discover a definitely metaphysical component, namely, the almost naive optimistic belief in "growth." That is not inductive, rather it is a premise based on faith. I criticize Dewey and his disciples, not for that faith but for the fact that they have not made it explicit. Had they done so, they would have reached the conclusion that the improvement of mankind is not necessarily achieved through more and more experimentation. It depends in which spirit and under which concept of man and the meaning of human life one is experimenting. Have we not now experimented ourselves nearly toward the abyss of civilization? Growth is not something which works automatically in human society; if it is to be sound growth, it involves decision, and such decision is never merely empirical, it is also intuitive. If Dewey had made it clear to himself and others that basically he stands in the idealistic tradition, in spite of the influences he received from Comte, Marx, and Darwin, the break between pragmatism and the earlier forms of philosophical and educational thinking could have been avoided.

As it is, we are now in a state of confusion. The modern methods of testing, statistics, and particularly behaviorist psychology, as it is still divulged in American universities, begin to change the picture of man. When the quantitative approach, which is legitimate in science, is uncritically transferred to the total concept of the human being, this being is more and more conceived of mechanistically. And there is a tendency to consider the fact that questions of ethics and spirit, at least so far, defy the quantitative method of science, a reason for a denial of their existence. But if we constantly ignore these questions and if we tell students that from a "scientific" point of view such concepts as freedom and will should not be used, then there is danger that essential issues of civilization become neglected.

Unless the totality of life is within the range of scholarly interest, people may well forget about it. This situation confronts us now to a considerable degree. In order to avoid misunderstandings, I have nothing against psychometrics, statistics, experimental psychology or any quantitative method *per se*. I am not on the side of those who are afraid of the new scientific discoveries because they might explode an old myth. If science — within its sphere of competence — tells us that an opinion is no longer tenable, let us be grateful. But if under the misused authority of science we are advised to have a one-sided picture of man which no longer relates him to the fullness of human experience and civilization, in other words, if pseudo-scientific dogmatism tries to replace earlier forms of obscurantism or even crowd out profound human wisdom, then there is reason for rebellion, because then there reigns neither truly scientific search, nor intuitive profoundness, but mental poverty.

As things stand today with education, we continue on the one hand to hold older idealistic concepts of education, especially when we speak of aims, values, and "the American way of life"; on the other hand we pursue the scientific and relativist approach, with no meeting between the two. Our students are constantly torn between these two interpretations of life.

This reflects merely the present philosophical and cultural situation. On the one hand American and European philosophers glorify science; on the other hand they attack it. In the 19th century, international scientific conferences concluded that there remained only a very few questions to be answered, and the riddle of the universe would be completely solved. Today there reigns despair in some, and a dangerous anti-rationalism in other camps. The attitude of science itself has changed considerably. As a matter of fact, our outstanding scientists seem to me more conscious and conscientious in regard to the omnipotence of the Newtonian interpretation of life and mind than some educators and psychologists. But these matters are not merely abstract problems of philosophy and education; they are problems of culture. Just as an unscientific transfer of mechanistic science into everything human may lead us into materialist totalitarianism, so incompetent attacks against science may lead us — indeed, they have already led us — into dangerous antirationalism.

III. *The Practical Implications*

When we now discuss the implications and applications of the foregoing considerations, we have to guard ourselves against rash conclusions. On the other hand, we must not establish a false dichotomy between science and the humanities, induction and deduction, empiricism and trained vision, for they all are part of the great endeavor to liberate man by use of his greatest gift, his rationality. On the other hand, we should not engage in false compromises. For instance, I am sorry and suspicious if certain theologians try to persuade themselves and others that modern microphysics has demonstrated the existence of freedom in the world. Not being a physicist, I cannot join in the arguments of physicists. But I know that conclusions from the molecular behavior of the innermost particles of nature to the problems of freedom and ethics indicate a false transfer of scientific discoveries to the deepest problems of humanity. Random behavior of atoms is not the same as human freedom. Furthermore, modern physics — at least so far —

is just as incapable of saying anything valid about the mind of man as was classical Newtonian physics. Indeed, man as a creature is connected with inorganic and organic nature; he has, however, special characteristics which are definitely human, and which physics can neither prove nor disprove. I remember an evening with Max Planck at the Harnack House of the University of Berlin. He then flatly denied the legitimacy of applying his discoveries to the phenomenon which, in old traditional language, we might call the human soul. Science has not yet been able to explain the existence of the scientist's reflective and systematic mind. By testing and measuring we cannot explain that there is a power in the world through which it can look at itself *more mathematico*.[1] The machines which solve the most complicated mathematical equations can neither set the problems, nor construct themselves. I dare doubt whether they will ever do so. Much though I am interested in experiments with animals, and I have many charming conversations with my German Schnauzer, I just cannot discuss with him *The New Yorker*. I do not intend here to go into metaphysics and argue about the old, from my point of view fallacious, problem of the "natural" versus the "supranatural." It depends on how we define nature. All I want to say here is that science when defining itself as that part of scholarship which uses quantitative and experimental methods, represents neither the totality of scholarships, nor can it tell us all, or even much, about the particular problem with which education and culture must be so deeply concerned, namely, the character and value of human aspirations. Reason may help us, but reason is more than science. What we need, in order to escape the confusion which is besetting education and the other humane disciplines of today, is a comprehensive theory of knowledge which makes it possible for us to understand the differences, but also the interaction and the possible synthesis of the inductive and the deductive, of the empirical and the intuitive methods of understanding reality. Also, we must understand the pragmatic method of living and at the same time realize that critical and pragmatic living would end in sterile conservatism and slavish adjustment to the environment if man did not possess the gift of transcendent vision.

Also, semantics and mathematical logic are splendid disciplines, as long as we see their limitations. We need them in order to be careful with our concepts. But if the founding fathers had first settled down to discuss all the possible logical meanings of freedom, the Declaration of Independence, the American Constitution and the nation which is built on their foundations would hardly be in the world. The founding fathers stuck faithfully to a visionary concept that man and this country could and should be free, and they knew perfectly well what they believed and for what they fought. Thus, when we now hear in scholarly circles that quality and equality, and freedom and causality exclude each other, they may be correct from an abstract logical point of view but, fortunately or unfortunately, life is not for logic; it is for living. All the great deeds of mankind are transcendent in the sense that they go beyond immediate reality. If you want to be *entirely* empirical, you run around like a squirrel in a cage with no possibility of escape.

It is hardly necessary for me to warn that the comprehensive theory of knowledge I hope for be not mistaken for an attempt at uniforming the human mind. Unity is not uniformity. I am profoundly grateful for the fact that we live in a pluralistic society, though we now have to defend it against sinister forces. But I know that a pluralistic society which embodies freedom and democracy is possible only if there is an acknowledged framework of integrating concepts around and within the plurality of thought and action. Without such a framework, pluralism degenerates into chaos. On the other hand, unelastic uniformity produces a rigid and dogmatic society which — paradoxically enough — survives only through the continual friction with that which it condemns, namely the phenomenon of heretics. To a large extent, that has been the history of the Christian Church.

What, now, does keep us together in our American culture of pluralism and freedom of inquiry?

Many Americans are so deeply embedded in their history and tradition, perhaps also so indifferent or complacent, that they do not think much about the fundamental values from which they profit. They tend to forget that the regulatory concepts of democratic law are centered in the idea of the inalienable, or natural, rights of man. This is an intuitive, though it is not an anti-empirical or irrational, concept. It is the great fortune of this nation that there was built into its very origin one of the greatest, if not the greatest, idea at which humanity has ever arrived. However diverse our thoughts may be, and however far apart our search for the solution to different problems may lead us, we are nevertheless united in the one profound conviction that men are connected with one another not only through the accident of their geographical neighborhood but through the participation of their individual minds in the common spirit that works within all humanity. For men can communicate with one another not because each one has his own special logic but because all take part in a common Logos. That may sound mystical, it is nevertheless a fact. One may prefer a religious, or an idealistic, or a naturalist explanation of the great Order which, on the level of man, produces the self-reflective element in life. There

[1] I recommend in this connection: Theodore Litt, *Naturwissenschaft und Menschenbildung*, Heidelberg, 1952 and J. Bronowski, *The Common Sense of Science*, Harvard University Press, 1953.

may be many hypotheses concerning the origin and nature of the thought element in life. But whatever the hypothesis, it constitutes the particular dignity of man that he can reflect on himself and the world, take distance and perspective, wait and contemplate. Whoever offends these qualities, offends his "inalienable rights" and does damage to him. History has proved this time and again, for whenever a society abandoned the faith in these rights, it fell back into a state of slavery and barbarism. Yet, who would deny that this faith was originally of an intuitive character?

Since I have been asked to relate our discussion on the scientific-humanist problem to our modern educational responsibilities, it may not be considered impolite if for reasons of brevity I refer to my last book, *Crisis and Hope in American Education* (The Beacon Press, 1951). Though not in the very same words I have dealt there with similar problems. In addition to all the technical details with which the conscientious educator has to be concerned, we need a kind of schooling in which the inductive and the intuitive approaches to life are no longer split off from each other, but converge. For many reasons — among them modern technology, pragmatic philosophy, American admiration of the "know how," "problem-solving techniques" in teaching and learning, decline of humanistic studies, and an almost total neglect of the contemplative life — our schools have become more and more inductive and suspicious of man's intuitive powers. Psychologically this involves a greater emphasis on *ad hoc* intelligence than on the emotional qualities of man. I am not by any means recommending "emotionalism." Emotionalism, or sentimentalism, is a sign of weak emotions, therefore we have so much of it. A passionate and emotionally strong man may be unrealistic, foolhardy, even dangerous, but he is not sentimental. What, together with Pascal, I admire most in man is his rational quality. But the more I have become convinced that there is man's specific dignity, the more I have also realized that reason is productive only if related to cultivated emotions. As Plato has said, if a mathematician is nothing more than just a mathematician, if he has not had an aesthetic training in the broad sense of the word, he will not be an educated man. And, also according to Plato, there is nothing more dangerous than the dialectically trained mind which is separated from the deeper grounds and responsibilities of life. This is something we seem to have forgotten.

But are our schools really inductive? Or are they primarily "verbal"?

Seventy percent of all our teaching — so I am told — is of the verbal kind. We think we can do justice to the students with a high degree of abstract intelligence, and by the same procedure help the non-verbal type. In this way we use neither the greatness of the deductive, nor the advantages of the inductive method. As a matter of fact, we satisfy neither the intelligent, who finds our diluted verbiage unattractive, nor the practical, who too wants another kind of meat. Many teachers of the last two grades of high school will tell you that half of their students, though perhaps trying hard to digest the knowledge they hand them, cannot do much with it. It has for them little or no practical application. Yet, these same students form the great bulk of Americans who will provide the concrete foundation of our civilization. If all human beings were potential university professors, civilization would go to pieces. What can we do for the practically inclined pupil, who will understand things better by the inductive method, and for the abstract type as well, who may be fascinated by the great human speculations whether arrived at inductively or deductively? If, on the one hand, we do not want to force both on a level where neither of them can do his best, if, on the other hand, we do not want the various talents in the nation to grow more and more apart from each other, we must show them the mutual interdependence of the deductive and inductive, the speculative and experiential, the intuitive and the experimental kinds of knowledge. In addition, to use the language of Pestalozzi, we must in our educational process unite the heart, the hand, and the head. Those who are primarily productive with their heads should nonetheless learn how to work with their hands; they should also understand the role of the heart in human society. Whatever the particular talent of an individual, it should not be developed in isolation, but with a view of the totality of the human being. Yet, according to the particular talent, there should be difference in emphasis.

We have applied in our elementary schools the "integrated curriculum." If such a curriculum fulfills its purpose, it should help our youth at a most susceptible and sensitive age to acquire the first feeling of the inner unity of the world. A child can be shown the relationship between his town, the history of his nation, the natural landscape he lives in, and his own self. Such an achievement would be important indeed, for it would carry further into life. But however great our admiration for the integrated curriculum may be, we must be realistic. After a certain point in the child's education, we can no longer pursue it. In their admirable zeal to find solutions on the secondary level, teachers have tried various integrative methods, such as fitting the sciences to history, history to language teaching, and so on. After a while such methods have generally been abandoned, not only because they involve endless teachers' conferences but also because they are opposed to the structure of advanced knowledge. If stubbornly pursued they keep growing adolescents on too low a standard of special knowledge.

On this advanced level of education, that which I call "transparent teaching" will gain better re-

sults. Whatever the special subject, we should teach it in such a way that it reveals the wider context and deeper background in which it is embedded. That does not mean that I advise the teacher of science to spend forty-five minutes on biology and then give a pious sermon about the miracles of life. I can imagine nothing worse. I recommend that in teaching biology, say, the end result be a profound reverence for life and our participation in the spending unity of nature rather than textbook knowledge, or skill in dissecting a frog or handling the microscope. To take another example, when I teach the American Revolution it should not be just a review of the external events, but an introduction to the great motivations which caused these events. The idea and responsibility of freedom, and the meaning of man's "inalienable rights" should emerge, not only as pale knowledge, but also as a commitment. Teaching in this sense of transparence reveals values which will not be forgotten, even if the details of the subject matter will no longer be remembered. You may call this kind of teaching philosophical, if you will; the name does not matter. The plain fact is that every teacher who really knows how to teach teaches more than his particular subject. He reaches toward its human meaning.

I should like our schools to teach young people not only how to acquire knowledge, but also how to act, and most particularly how to wonder. The three belong together. The exciting and combining element in all true learning is the sense of wonderment, that which the Greeks called *to thaumazein.* That person is creative who never ceases to be astonished. Sometimes, alas, I am afraid that through our teaching we kill this precious capacity. Out of wondering comes comparison. The object in which we are interested stimulates us to envisage ever widening horizons of inquiry.

In our schools let us help young people to acquire a sense for both the deductive and inductive elements of knowledge. Let us also show them how rational thinking can be applied practically. But in doing all this, let us stimulate and preserve as the pervading element in man's way toward maturity the sense of reverence and wonder which has been, and will forever be, the source of man's greatest deeds and visions.

"It is impossible briefly to do justice to the truth that all the great religions have implications which are philosophic or metaphysical in nature. One has but to mention the inroads which 'scientism,' the various determinisms (evolutionary, psychical, economic, historical), logical positivism, scientific humanism, anthropological naturalism, and others—all have made toward creating scepticism about the reality, validity, and potency of spiritual insight, in order to realize that college students are peculiarly subjected in the nature of their intellectual environment to influences which can readily encourage blind spots about the life of their spirits and of the Spirit.

"Indeed, within the departments of philosophy, to say nothing of the outlooks of teachers in other fields, the metaphysics taught or implied can too often today be of a sceptical and unspiritual character. Moreover, the value of any metaphysics may be stoutly denied by highly regarded teachers.

"Problems of the validity of rational faith as distinguished from knowledge; of the absolute character of scientific knowledge; of decision, commitment, and dedication, as compared with a 'take it easy' attitude; of established criteria as to right and wrong; of the meaning of a Law of Love; of the reality of a basic and pervasive orderliness in the universe—all these aspects of human tension not only can be but are ignored in the instruction (and comprehension) of too many college teachers. Or, in a more generous interpretation, some of them believe (mistakenly, in my judgment) in a separation of their personal religious convictions and of their presentations of instructional content and emphasis. The former is thought to be private and personal; the other is intellectual and 'scholarly.' And even the inconsistency of such a dichotomy all too rarely receives critical scrutiny by teachers who should know better.

"It nevertheless remains true that recently more and more of the most profound scientific scholars are voicing convictions which are basically infused with spiritual insights and theistic interpretations. The obsessively 'objective,' 'neutral,' and hyperesthetic preconceptions of some of the humanists and social scientists are being left behind by the convictions and pronouncements of these wise exemplars of the deepest disclosures or intimations from the natural sciences. There is still, however, a long way to go if the historic insights of the human spirit are to be given their day in the court of the college classroom of scientists, humanists, and social scientists. And I see no way for this advance to be hastened unless and until more college teachers have clearer beliefs about the aims and goals of their own instruction and about the overtones of conviction and insight about basic life outlooks which they feel able to sincerely articulate."—from *"Developing Spiritual Insights," by Ordway Tead, in Religious Education, Vol. XLVIII, No. 4, p. 223.*

SOCIAL PHYSICS AND THE CONSTITUTION OF THE UNITED STATES*

John Q. Stewart

Princeton University

Faith in Natural Law as a Basis For Ideology of the Revolution

The fourth Randolph, New Hampshire, conference on Social Physics was held July 6-11, 1953. Expenses were met from the Rockefeller Foundation grant to Princeton University for the study of social physics, directed by Professor John Q. Stewart. We quote a section of the conference report:

"Social physics has attained the threshold of a period when more rapid development is foreseen and should be urged. It now presents the framework of an inclusive pattern for description of social phenomena in the large, and for aiding in the formulation of many types of social policies. This pattern is set by two main ideas drawn in large part from physical science, but nonetheless humanistic in structure and application.

"One idea is that 'Trimmer devices'[1] play in social phenomena the role which in physical phenomena is taken by machines. A Trimmer device or system may be defined as any arrangement B which has a physical existence, and which when subjected to a stimulus or input A gives rise to a corresponding response or output C. The rule according to which a given response C follows from a given stimulus A is of course in physical cases related to the structure B of the device, but the rule conveniently may always be designated by a separate letter D. This description is sufficiently general to include very many types of machines and organisms—for example, automobiles, amoebas, and boards of aldermen. The notion of stressing the sequence stimulus-situation-response is by no means new, but members of the conference recognized in Professor Trimmer's description the link needed to complete the thought-bridge they were building from physics to humanism.

"The second chief idea for developing social physics is that all the inputs and outputs, all the stimuli and responses in the social scene must be catalogued and described with reference to 'social values,' which correspond in their dynamism and mutual inter-relations to the forms of physical energy so significant in physical science. Six forms of physical energy have been listed in papers before the American Physical Society: kinetic, elastic, gravitational, thermal, electromagnetic, and chemical. The first three, Professor Stewart suggested, show up in a rather neglected branch of general social study which can be called social mechanics. This branch deals particularly with time, space, and mass of material as social controls. A number of publications, by the late George Kingsley Zipf, Stuart C. Dodd, and others, show that human behavior when described in such terms conforms to mathematical regularities closely resembling the regularities of physics."

[1] John D. Trimmer, "Response of Physical Systems," John Wiley and Sons, Inc., New York, 1950, pp. 1-6.

Physics and politics are treated nowadays as subjects intellectually unrelated — connected only by such unpleasant links as atom bombs. Things were different in the eighteenth century. Faith then in a rational structure of "natural law" common to all disciplines formed a principal part of the ideology of the American Revolution, culminating in the Constitutional Convention held in Philadelphia May-September, 1787.

Woodrow Wilson has pointed out the influence of Newtonian mechanics on the Federal Constitution. Writing in 1908 he said that its makers followed "with genuine scientific enthusiasm" the political interpretations of Montesquieu — under whose touch "politics turned into mechanics." They balanced off the President against Congress, Congress against the President, and each against the Courts. By the device of the two-chambered Congress the big states were balanced against the little ones. The imitation of the equilibrated orbits of the planets, where gravitation pulls one way and centrifugal force another, was a conscious one. This is shown by examples preserved from the debates, and in passages in the Federalist papers.

In those days mechanics was almost all that was known of physical science. Benjamin Franklin, himself a member of the Convention, understood electricity as well as anyone. Joseph Priestley, early chemist and the discoverer of "dephlogisticated air" (oxygen), was soon to become a resident of the banks of the Susquehanna. Benjamin Thompson, a Massachusetts Tory who had fled to Europe, would live to be an early investigator of heat and thermodynamics. An eminent Philadelphian seventy years later, Henry C. Carey, pioneer economist and sociologist, made an important application of gravitation in sociology, treating distance and numbers of people, as major social factors — something many practitioners of social science have not learned to do even today.

In 1953 we have far greater knowledge of physics than at the time of Franklin or of Carey. But belief in uniform natural law, applying alike to nature and to man, has been replaced by such restrictive philosophies as British empiricism, which insists exclusively upon the separation of specialized subjects, and John Dewey's influential instru-

* Based on a talk given in Philadelphia, April 1953, in the course, "The Frontier of Knowledge: Integrative Concepts in Science, Philosophy, and Education," conducted by the Foundation for Integrated Education under the sponsorship of the Committee for Integrated Education in Philadelphia.

mentalism, which denies the existence of natural law.

We have at Princeton University, with current support from the Rockefeller Foundation, a little project in social physics. Social physics did not start with the intention of putting new vim into the Revolutionary ideology, but its acceptance will have that as one by-product. Social physics begins with describing physical science in a very general way, featuring six basic concepts, known as physical dimensions, in terms of which all other quantities and relations in standard physics are expressible. The list of six may be taken as time, distance, mass, entropy, electric charge, and number of molecules. Corresponding to each dimension is a specific type of energy — kinetic, elastic, gravitational, thermal, electromagnetic, chemical.

In the suggested transfers from physics into sociology, human "values" are featured as corresponding to those physical energies. Values relate to the fundamental urges by which men live, and they are the very stuff of living. A list of six social values is suggested. The first three may be called moving, expanding, and congregating. Involved is the tendency of people to acquire living-space by spreading over available geographical area, and their counter-tendency to intensify their opportunities for varied activity by concentrating toward densely populated centers. These rather mechanical phenomena have been neglected by conventional social science. Social physics has succeeded in describing them in formulas resembling formulas of physics. The Philadelphia-New York metropolitan concentration is the world's peak of sociological intensity in these respects, and with its fortunate history and continental resources can become the world's peak in all others.

Suggested as pertaining to the second set of three social values are phenomena associated with reason, feeling, and authority. These phenomena form the chief subject matter of the humanities and of standard social science. Through the developing theory of codes and information, which traces to Francis Bacon in 1609 and has recently been elaborated by telephone engineers, phenomena of reason and meaning offer useful parallels with the physical subject of heat. Likewise phenomena of person-to-thing and person-to-person feeling can be shown to have some analogies with electromagnetism — hungers being cancelled by their corresponding satisfactions just as plus and minus electric charges or magnetic poles neutralize each other. And social organizations which authority creates remind us of the molecules of chemistry, the constituent people being like social atoms.

A majority of the fifty-five delegates who came to the Constitutional Convention were lawyers. Unlike most lawyers now they believed firmly in the natural law which is above and beyond all human regulation, and has universal applicability in just the sense that the laws of physics have. We may assert that the logic of these early social physicists was strikingly more modern than the limited physics at their command. Before heat, electricity, and chemistry were well understood they recognized in 1787 the necessity for facilitating within the Federal government the rich interplay of reason, feeling, and authority. This they accomplished by the famous division of powers among the Courts, Congress, and the Executive.

Congress responds to the feelings and needs of the people. The Executive is the authority which enforces the legislation so enacted, subject to the rationally constituted stability of primary rules as interpreted by the Courts. However, the people retain final authority and can amend the Constitution.

The relation of the main body of the Constitution to its first ten amendments, or Bill of Rights, also has significance for physics and social physics. The Constitution was a consciously planned application, made within a duration of four months, of all available knowledge to the design of political machinery for relating citizens en masse. The Bill of Rights was quickly added because debaters at once demanded recognition also of the lively theater where citizens act not in great groups but as individuals. It represents the adopting of precepts which had grown slowly and unplanned in the centuries of development of English Common Law. We may liken the body of the Constitution to principles of a rigorous "field theory," such as Newtonian mechanics is, while the Bill of Rights not too fantastically can be said to incorporate corresponding "quantum conditions."

Both in physics and politics the contrast between mass regularity and individual spontaneity is subtle and paradoxical. The corpuscle or social atom engages in action which would be disruptive or impossible for the multitude. But physicists did not find this out until our own times!

In the mid-nineteenth century Karl Marx failed to allow for the role of the free individual in society. While Communists conform to our own Revolutionary tradition in believing in the existence of natural law, social physics and the Western political tradition show that their expression of it is signally inadequate.

Of course, in a single hour no adequate understanding for a general audience can be conveyed of so ambitious and wide-ranging a subject as social physics, with its background of Leibnizian and Hegelian philosophy. To stress in a talk in Philadelphia the relations of social physics to the Constitution of the United States may help a little in clarifying both — now that after 165 years physical science not only has caught up to the wonderful Convention of 1787 but at last has forged ahead. Full criticism and development of the general principles outlined in this talk will require enterprise of research teams representing the entire gamut of the sciences. In just such opportunities for intellectual and practical advances lies the mission of the Foundation for Integrated Education.

SOURCE READINGS: INTEGRATIVE METHODS AND MATERIALS

The Source Readings which follow constitute those items and abstracts most pertinent to integrative education which have come into this department from readers in a variety of fields. Readers have not yet, however, been assigned to cover all major disciplines.

Emphasis in this material is upon: (1) developments in specialized fields which generate conceptual implications for knowledge in general; (2) discussions of conceptual and philosophic developments which are within a discipline but which have general implications. Other criteria which govern these selections of materials for Source Readings are studies in deductive-exact scientific process; and in the relationship of the whole to the particular.

The Need For Public Understanding Of the Role of Scientific Research

"Society in the Grip of Science," by Dr. H. A. Spoehr, was printed in *Impact of Science on Society*, Vol. IV, No. 1, Spring, 1953 (from an address before the Pacific Division of the A.A.A.S.).

Theme of the address is the extent to which modern society is in the hands of science and the consequent responsibility for the scientist, particularly "to make intelligible to the public the role of fundamental scientific research for the welfare of society . . ." Dr. Spoehr feels that "science has been remarkably successful in solving particular problems within well-defined fields and disciplines, and applying these discoveries to practical ends. Science and industry have also been very successful in convincing the public of the value and importance of technical education. Where we have failed, especially in our general education, has been to see our problems whole . . . It is only as scientists themselves understand these broad aspects of their work and make a special educational effort to clarify these relationships that we can hope to attain a public comprehension of the role which science is playing in our social life."

Dr. Spoehr points out that the intellectual or broadly cultural influence of science is far more fundamental and lasting than the complexities resulting from applied science. ". . . Not only the vast general public but all too many scientists themselves pay little regard to the long and arduous struggle through which man has gone to attain freedom of thought . . . This freedom of thought, this independence from authority and this sovereignty of honest evidence constitute the foundation of modern science on which all of the real achievements are based. Of these achievements the most significant and valuable fruits are the great laws of nature. To apply the term law to these is in a way a misnomer and is much misunderstood by the unscientific, for these laws have not been promulgated through authority, nor are they decrees or edicts. They are the summation of experience . . . subject to modification . . . to evolutionary change. But such changes are effected not by decree or injunction, but on the basis of new evidence . . ."

Several examples were given of modes of thought not in accord with a philosophic understanding of science: "The true scientist welcomes criticism . . ." yet ". . . As a nation we are peculiarly sensitive to criticism . . . Scientists are essentially pioneers and progressives, and progress rarely goes hand in hand with conformity . . . The founding fathers of this nation were surely not conformists nor were the organizers of our great industries, which in a large measure have made the growth and survival of the nation possible . . ." yet "we are experiencing in America today the pressure and influence of conformity as never before in our history . . ."

"If science in its broadest and most useful function to mankind is to survive, it must not conform to the popular belief that its main justification is the providing of immediate material welfare and security. These have their place in every society, and science willingly contributes to these ends. But scientists must . . . educate their sponsors and society in general to an understanding of the function of science in discovering man's relation to his environment. This environment need no longer be regarded as a manifestation of some capricious supernatural being, but rather as the expression of universal scientific laws. Man's behavior and control of himself in adjustment to these basic laws constitute conformity on a far sounder basis than conformity to man's whims and immediate material desires. And it is, moreover, of the very essence of science, as more sound information is collected through research, that these universal laws can be modified and amended.

"It is also of the very essence of science that in order to amend, extend, and modify our basic concepts of nature, science must be able to operate in an atmosphere of freedom . . . Freedom for the pursuit of science is a trust. This trust carries a responsibility for the highest principles of human thought, the search for truth . . . Science can never become a profession, in the true sense of the word, until it gives more serious consideration to the ethical principles and social relations involved in its activities. If ethical standards are not developed by the scientists themselves and a high level of professional honor is not maintained by them, it is inevitable that rules and oaths will be imposed

upon their activities from without. And this will be done by members of society wholly unfamiliar with the kind of freedom essential to the growth of science. The scientist's vision must reach beyond mere concern for the advancement of science. He should not take refuge in the subterfuge that science *per se* is amoral. Science gains its importance through its impact on society."

The Involuntary Destruction Of Science in the U. S. S. R.

Dr. Conway Zirkle, professor of botany at the University of Pennsylvania, discussed "The Involuntary Destruction of Science in the U.S.S.R." at the December meeting of the A.A.A.S. (reported in *The Scientific Monthly*, May, 1953, pp. 277-283).

He briefly surveys the climax of the Lysenko controversy on August 7, 1948, when T. D. Lysenko, President of the Lenin Academy of Agriculture, announced that the Central Committee of the Communist Party had approved the line taken by the attackers of genetics. This was followed by outlawing of the science of genetics and recantation of five Russian scientists.

Dr. Zirkle comments that "To many non-scientists it seemed that there must really be 'something' in the newer Russian stand after all. The higher authorities in Russia certainly could not be as foolish as they appeared . . . Those who are equipped technically to evaluate the doctrines which displaced genetics, however, recognized at once that they were not new, but were only a resurgence of some archaic errors which had been abandoned during the past century . . . Genetics denies the inheritance of acquired characters, and this type of inheritance promises so much so easily that it has always been a favorite of those who want to make over mankind in a hurry."

Dr. Zirkle traces the current Soviet attitude toward genetics to the not generally realized hostility of Marx and Engels to scientific objectivity. Although they praised science consistently, they denounced and misrepresented scientific theories which conflicted with their Communistic postulates. Lenin attempted to foster science by training scientists in wholesale lots, but denied a university education to many of the children of the intelligentsia and professional classes, which produce the majority of the scientists of the Western world. For the large numbers of prospective scientists who could not pass their university examinations, the Communists had a collectivist remedy — dividing the students into small groups who pooled their knowledge and took the examinations in a body. This, of course, lowered the standards of Soviet science considerably. Also, the outcome of the conflict between genetics and Marxian biology taught the scientists that "the road to safety was clearly not to be found by a careful and honest interpretation of experimental data but by preserving a rigid Communist orthodoxy, by endorsing just those doctrines which are compatible with the beliefs of the dominant clique . . ."

"If all the sciences in Russia had sunk to the level of those which have been injured most, the Communist regime could soon be dismissed as an unpleasant episode in the long installments of human history; its internal weaknesses would soon reduce it to impotence and the world's worry would be over. We must recognize, however, one fact which might prevent the deterioration from spreading and becoming uniform throughout all science. There are fields such as engineering and applied physics where the results of bad science can be discovered immediately. In these fields quackery does not last long. Here, at least, if the political authorities cannot recognize good scientists they can at least discover quacks, and by a ruthless elimination of the latter, may even maintain relatively high standards. On the other hand, the situation is very different in medicine and agriculture, for in these fields there are none of the simple tests which may allow a layman to reach a sound and discriminating judgment. In spite of quacks and cultists, patients recover and crops grow. In medicine and agriculture only honest scientists can evaluate the current practices. A large part of Russian science, however, falls somewhere between engineering and agriculture in the direct measurability of its practical achievements. In these intermediate sciences we would expect quackery to flourish inversely as the ease of identifying quacks. We certainly cannot judge all Russian science by what happens in one or two fields."

Dr. Zirkle summarizes the status of Soviet science from the A.A.A.S. symposium on Soviet Science (1952):

1. Genetics has been extirpated in Russia and its place taken by an archaic quackery.

2. Statistics has lost its basic honesty. It is now used to falsify data for propaganda purposes.

3. Psychology and psychiatry are practically dead, with little chance of recovery.

4. Biology and agriculture are so permeated by quackery that nothing of importance can be expected from them.

5. Physiology, pathology, and medicine are forced into a rigid and stupid orthodoxy which contains much quackery; their future development is inhibited, but some sound practices still survive . . .

6. Geology is subjected to political attacks and pure research is discouraged.

7. Astronomy includes the amusing quackery of astro-botany, or the study of plant life on the planets. Certain theories as to the origin of the

solar system are forbidden, but nevertheless much excellent work is being done by Russian astronomers.

8. In chemistry, certain theories, such as resonance, are forbidden, but much good chemical research is still being done.

9. The basic philosophical background of modern physics is labeled "idealistic" and is condemned. However, in physics, many of the words are separated from their meanings so that the basic research is probably not hurt by its accompanying verbiage. Russian physics is definitely good.

10. Russian mathematics is truly excellent, a science of which any country might be proud.

11. Engineering in Russia is probably adequate for all military and civilian purposes.

Use of Indian Indigenous Drugs In Treatment of Mental Diseases

The American public has not adequately awakened to the prodigious activity which is going on in India along scientific, cultural, agricultural, and other lines. At present, development is necessarily chiefly practical. India's ancient philosophy and attitude is, however, already beginning to make itself felt slowly, for the present, but with promise of marked acceleration.

Even before the establishment of free India, the government had begun to take some interest in native medicinal arts. The present writer was concerned in one of these early steps in Madras, which led to the establishment of the Institute for Ayurvedic Medicine, with Dr. S. Srinavasamurti, of the Indian Medical Service, as its head. He is an authority on the Indian philosophical theory of medicine, as well as a doctor of Western medicine.

We have now received from Dr. R. A. Hakim, consulting psychiatrist at the Civil and Mental Hospital, Ahmedabad, India, a report on a test of Indian indigenous drugs in the treatment of mental diseases. This was presented at the Sixth Gujrat and Saurashtra Provincial Medical Conference in Baroda, January, 1953.

There are two important medical systems in India: that of the Hindus, called Ayurveda, derived originally from the Yajus Veda, and that of the hakims of the Moslem tradition, called the Unani system. The Moslem influence came into India through Persia, where the invaders picked up the Irani form of the Indo-Aryan tradition. In India they met this culture in a much more vital and complete form, the Vedic aspect. These historical events account for much of the difference between the two medical systems, Unani and Ayurvedic, although they have a great deal in common. The Aryan system is probably much more richly equipped philosophically speaking. Both use the natural medicaments available in India, and tend today to unify.—*F.L.K.*

Following is a brief summary of the findings which Dr. Hakim reports:

In the view of recent theories of metabolic disturbances of the brain as related to mental diseases, Dr. Hakim used Ayurvedic drugs alone and in combination with shock therapy in the treatment of a number of types of mental disorders. Among these were schizophrenia, manic-depressive psychosis, paranoid state, senile psychosis, hysteria, hypochondriasis, and epilepsy. The Ayurvedic drug consisted of a mixture of six native plant products that have been known and used for centuries in India.

One hundred forty six cases were reported; 45 were given shock therapy only, 60 received only the Ayurvedic drug, and in 41 cases shock therapy and the drug were combined. Dr. Hakim reported a recovery rate of 31% in the various types of psychoses treated with shock therapy. Those given Ayurvedic drug alone showed a recovery rate of 51%, and those treated with a combination of drug and shock therapy showed a recovery rate of 80%. In the psychoneuroses the drug ameliorated the tense condition of the patient.

The author reminds us that it is too early to study the relapse rate in these cases and asks that the value of the drug in the treatment of mental disorders receive further investigation.

This report is particularly interesting in the light of Dr. Claudius F. Mayer's ideas on the "Metaphysical Trends in Modern Pathology" reviewed in MAIN CURRENTS (Vol. 9, No. 4, pp. 121). The dynamics of a living organism does not permit of differentiation into discrete elements. There are many varieties of this holistic approach but all agree "in the open revolt against the age-old anatomical idea, against the localization of disease in structural parts of the body." Dr. Mayer recognizes the trend toward re-integration of the individual and its relation to its environment. Several of the "metaphysical theories of disease offer means for such reintegration by synthesis of the accumulated details."

The Need for Theory In Adult Education

In a paper, "The Need for Theory in Adult Education," (*School and Society,* June 27, 1953) John B. Schwertman, Director, Center for the Study of Liberal Education for Adults, Chicago, points to the confusion of concepts regarding the education to which thirty million American adults subscribe.

This confusion in the minds of most college people divides adult education into three categories: (1) academic programs leading to degrees for people who cannot come to a campus in the day-time;

(2) non-credit short courses, etc., conducted by "regular" universities and colleges; (3) the type of courses given by high schools, YMCA's, adult education councils, etc., and which are not the concern of the university.

Adult education, as "day school at night," already embodies some theory to support it. But as for adult education in general, the author contends that ". . . the main obstacle to better adult education is the lack, almost total lack, of an appropriate way of looking at adult education."

At this juncture, the author comes forth with a statement which should well be at the mast-head of every program of integrated education which tries to tell its students what we mean by concepts:

"All about us lie observable events which we may call practices. These practices, if they are rational, derive from principles. These principles are back-stopped by concepts, or conceptual framework. And concepts are in turn derived by intellectual tools or habits, which might be called ways of looking at reality.

"Most persons would agree that bodies of theory take form around principles and concepts. That is, principles and concepts get ordered and systematized; whereupon many practices and events are produced or justified. Bases for choices are thus established, objectives take shape, content is formed, and standards for evaluation emerge.

"We should not, however, lose sight of the fact that behind the principles and concepts lie ways of thinking which give rise to them."

Using the unintelligibility of Einstein when he first made his proposals as an illustration of the fact that original thinking cannot be done and discussions cannot be enlightening until basic concepts are shared, Dr. Schwertman continues:

"Adult education may or may not be of the magnitude suggested by the reference to Einstein, but the analogy may help us see that there do occur times in which ways of thinking have to be shifted to entirely new bases of reference. Such times appear historically to occur when very large events, having evolved over a period of time, suddenly achieve a degree of fruition in which they struggle for recognition as identities in their own right. Such events, growing slowly, have the effect of sneaking up on us. All of a sudden, here they are! There is no adequate way to describe them, much less to understand them, and still less to appraise them."

There follows a brief analysis of some of the current concepts, arising from inappropriate direct transfer of thinking about traditional education to the problems of adult education.

". . . There are other ways, of course, ways of looking anew at what subject-matter fields can do for adult nonspecialists, and ways of fashioning more clearly the current fuzzy thinking about community needs. The point, however, is that many traditional ways of looking at 'needs' make either less sense or non-sense when applied to adult education.

"If knowledge is unified, life and educational experience are not less so. A 'grade' or a 'course' or a 'degree' is no panacea for the educational needs of adults . . .

"Learning principles and educational practices more appropriate for adults will emerge only when adult education — like medical and legal education, like the American high school, like early childhood education — develops a reason for its existence. In short, adult education needs a theory of its own, if it is to discover what it really is."

An Integrative View of Biology

An integrative view of biology is taken by Robert Bloch (Yale University) in a recent article, "Goethe, Idealistic Morphology and Science" (*Amer. Sci.* 40 (2): 313-322. 1952):

"The various disciplines of biological science during the 19th and 20th centuries have set forth vastly differing ideals. Individual and comparative developmental history, evolution, developmental mechanics, and the systems proclaiming the autonomy of living things, i.e., vitalism and holistic organicism, differ greatly from the idealistic morphology of Goethe, but there are many conceptual relationships. The proponents of modern organismic biology and philosophy, for example, express much appreciation of Goethe's concept of the organism, which is basically holistic. In Goethe's time the science of plunging to the heart of one's impressions was still new, and Goethe himself rather avoided these methods. He accepted the concrete manifestations of nature innocently and allowed his senses to draw from whatever the phenomena would yield of joy and enlightenment. When in 1790 Goethe published his most famous botanical work, the 'Metamorphosis of Plants,' the concepts of evolution and cell theory were non-existent. There was no knowledge of cells or nuclei, or genes, and no discussion of developmental potencies or determinants. Yet this type of concept has appreciably contributed to the understanding of many morphological problems, including that of organ homologies." (Reviewed by H. J. Dittmer in *Biological Abstracts.*)

Data on Systematics of Evolution

The recent report (*Time,* July 20, 1953) of the discovery of complete skeletons of diprotodons, by Dr. Ruben A. Stirton, Professor of Paleontology, University of California, presents more evidence toward the solution of one of the major puzzles of evolution, its systematics.

The diprotodon was the marsupial equivalent of the large slow-moving herbivorous mammalian tapirs. It was but one example of those beasts, the

pouched mammals, which below Wallace's "line" of demarcation, in isolated Australia, ran a course remarkably parallel to that of the true mammals. There are today in Australia pouched carnivora, pouched marsupial moles, pouched kangaroo and wallabies, the latter corresponding to deer or antelope, but without horns. How was it that these early mammals, thus isolated, developed in so many cases varieties corresponding, over and over, to the placental mammals elsewhere in the world? One would suppose (if one argued from neo-Darwinian premises) that the types would not have displayed this one-to-one correspondence between the many kinds of aggressive and peaceful placentals elsewhere, and the generally milder mannered pouched marsupials and their fewer fierce types. (The old man kangaroo is a terrific fighter on occasion, able to pick up, hold under and drown, a sizable hunting dog, and to kill a man or beast with a single kick.)

Dr. Stirton's find puts new emphasis on the need to inquire into the systematics of the evolution of form and habit, to match the systematics of genetic laws.

The Chief Aim of Education

The thesis, "Integration as the Chief Aim of Education," is presented by Daniel Ammen Brooks in a recent issue (Vol. 1, No. 2) of the *Journal of Human Relations.* Part one appeared in Vol. 1, No. 1.

Dr. Brooks' initial theme was that "a condition of more complete integration is, or should be, the chief aim of education . . . the concept of integration centers about the idea of a wholeness, a wholesomeness, a unity, a healthfulness, an integrity, within the individual personality, within social groups, within the whole great unity, Nature, and within the all-encompassing Existence which we call God."

In the present installment Dr. Brooks attacks the problem of what education can do to promote integration:

". . . *Integration is not a condition merely to be sought for, but integration is a condition that already exists.* From whatever angle it is approached — evolution, unity of the spirit, unity through natural law, unity of the individual, unity through intellect, unity through the continuity of human life — we find a unity already in effect.

". . . The educator's task is begun when he recognizes that the elements of wholeness are already presented before him, and that *his task is to aid the student to realize that this unity exists; to aid him to realize that he himself is his first example of wholeness,* and to assure him that throughout his life his experience will bring before him an infinity of examples of the integration of the universe . . . *the most fundamental element in education is the integration or personality of the teacher.* . . . The influence of the curriculum, the influence of the educational building is small: the influence of the teacher is great.

". . . No better source for the enrichment of the teacher's concept of social integration can be found than the philosophic and educational writings of Friedrich Froebel (1783-1852) who led the way in pointing out the power of the school in furthering the integration of children.

". . . Interschool, intercity, interstate, and international *cooperation, not competition* should be the keynote. . . .

"Further investigation . . . will lead the educator to consider to what extent the instances of the weakening of integration conceded in the first article — juvenile antisocial acts, weakened family ties, class and race conflicts, and dissolving national and international alliances — are traceable to failure to teach our children at an early age the interdependence of all mankind; failure to develop the sentiments of goodwill and friendship and brotherhood that grow out of happy experiences when in association with others; and failure to develop that summit-sentiment, *character,* typical of the integrated individual . . .

". . . *the teacher most valuable in furthering integration will be, as always, the teacher who can see Nature as a whole, and who can help the student to maintain his sense that he, himself, is living within Nature, a part of all that he sees, hears, and senses about him — one with the atom and one with the stars; that all that we see and all that we are operate under and through and by the Maker of Laws; that we 'see through a glass darkly'; that man, still the new-born infant of Nature, acts infant-like.*"

Abstracts Pertinent to Integration

The following are abstracts of those papers pertinent to integrative education presented at the National Academy of Sciences autumn meeting at Washington University and St. Louis University, St. Louis, Missouri. These abstracts are taken from Vol. 116, No. 3020 of Science.

Man's Awareness and the Limits of Physical Science

A. H. Compton, Washington University

Attention is called to the conflict between the views of Bohr and Schrödinger regarding the nature of the physical world. Bohr considers this to include only that which can in principle be verified by observations using material instruments. Schrödinger introduces the hypothesis of a physical continuum, typified by the concepts of wave mechanics, whose changes follow a strictly casual determinism, but of which observations with ma-

terial instruments can give only partial information.

Making use of Bohr's evidence that one's awareness of his intentions makes possible the prediction of his actions more definitely than is in principle possible from physical observations, a category of ideological reality is introduced. This category includes feelings, ideas, intentions, etc., of which one is immediately aware. It is distinguished from the physically real world as defined by Bohr. In terms of this distinction, Schrödinger's determined continuum has ideological but not physical reality. The question remains whether this continuum may have objective reality outside the physical world.

The usefulness of one's awareness of his intentions in forecasting physical events suggests the following rather obvious hypothesis that there exists an objective world regarding which physical observations reveal one aspect and man's awareness reveals another. Such a world is not evidently related to Schrödinger's continuum. The present hypothesis can, however, be used in reconciling the "outer" physical indeterminateness of man's actions with a high degree of "inner" determinateness. Here seems to be an answer to Schrödinger's criticism of the concept of an undetermined world as violating the reasonable inference of self-determined actions associated with the sense of moral responsibility.

Certain Temporal Factors in Audition

Ira J. Hirsh, Central Institute for the Deaf and Washington University

This theoretical presentation attempts to show that the four basic physical dimensions, three of space and one of time, are not all equally important nor in the same order of importance for perception in all sense modalities. Theoretical and experimental literature on visual perception reveals a consistent preoccupation with spatial dimensions (primarily the two of the frontal plane), with relatively little concern for visual changes in time except for the studies on perceived movement.

Everyday visual perception is characterized by the discrimination of various shapes, extents, textures, and other qualities that are spread out in space. The referent for visual perception is the *object*. The important dimensions, therefore, are the properties of objects. Auditory perception, on the other hand, can rarely be referred to objects. We do not hear objects, but rather *events*. And the important dimension, therefore, for audition is the basic dimension for events — namely, time.

Study of the perception of time has been concerned mostly with comparison or absolute judgments of duration. It is proposed that time be used as a dimension in which stimuli are arranged or patterned in order to provide data that can describe the principles of operation of time-based sense modalities, such as audition.

If the above notions are correct, *visual acuity*, a measure of an *interval of space* between two visual stimuli that are perceived as two, is the important measure for predicting visual capacity for reading and other forms of discrimination of spatial patterns. The implication of these notions for audition is that the basic measure of auditory capacity is another *interval*, now *of time*, that is necessary in order that two successive acoustic stimuli are perceived as two. Lack of such a measure of auditory capacity, which is analogous to visual acuity, is largely responsible for the lack of good correlation between extant psychophysical measures of audition and the ability to perceive and discriminate adequately everyday auditory phenomena.

Exploratory experiments on temporal acuity or resolution in vision, audition, and tactual vibration reveal that these three senses differ widely with respect to the perception of temporal patterns. These, together with comparative results on auditory and visual fusion, reveal the clear superiority of audition when rapid stimulus changes are to be discriminated.

The Dynamics of Total Systems in Psychology and Biology

George L. Kreezer, Washington University

The rapid rate of progress in the physical sciences and engineering has often been attributed to the effective use of mathematical methods. The possibility of using similar methods for theoretical treatment of the response systems of living organisms is not so generally acknowledged. Among the outstanding obstacles are the extreme complexity of biological systems and the lack of sufficient information to permit writing the differential equations of a given system without extensive assumptions. The present paper outlines an approach that attempts to by-pass these difficulties through the application of concepts derived from the engineering treatment of linear systems. Specifically, it attempts to derive mathematical functions to represent response systems from experimentally determined curves of the temporal response of the total system to specified forcing functions. It can thus be designated as an investigation of the dynamics of total biological systems, through a generalization of the meaning of dynamics in physics.

This approach is being carried out in two stages: (1) the development of methods for deriving system functions (transfer functions) from the response curves of biological systems, on the assumption that these systems are linear, and (2) the determination of signs of non-linearity, from response curves, and the development of methods for taking account of them in the derivation of system functions. Illustrative records are presented of transient response curves of some psychological and biological systems, computer methods for deriving transfer functions, and some of the different types of nonlinearity observed. A graphical method for dealing with nonlinearity is briefly described.

INTEGRATIVE PROGRAMS IN COLLEGES

Recommendations for a New Approach To the Field of Medical Education

Comprehensive recommendations for integrated education in medicine were made in a report of the Committee on Undergraduate Medical Education to the American Surgical Association, printed in *Transactions of the American Surgical Association,* Vol. LXVIII, pp. 523-554, 1950.

The preamble begins: "In May, 1948, the Council of the American Surgical Association appointed a committee to study the role of the surgeon in undergraduate medical education. In the charge to the Committee, President Gallie and the Council stressed that the Association had for a number of years centered its educational thought on the postgraduate training program of the surgeon, and that attention to the undergraduate phase of medical education should be renewed . . ." Members of the committee were Oliver Cope, chairman, Michael E. DeBakey, Daniel C. Elkin, Robert M. Janes, Carl A. Moyer, and Philip B. Price.

The committee felt that the primary objective of medical education was "to give the student a comprehensive concept of man and his diseases and to inculcate those habits of mind which will enable him to enter without handicap any one of the fields of medical practice and research . . ." Stressing the need to focus on man, the committee felt too much attention was given to the experimental animal, particularly in the first year. Also, an aim often neglected was giving the student sufficient understanding of the breadth of medicine for him to know his own limitations.

In notes on the philosophy of medical education, the committee presented the following crucial discussion of education by concepts:

"Medical knowledge is composed of facts. When isolated, facts are the stumbling blocks of medical education. When integrated into concepts, they become the building blocks of understanding.

"The easy way to teach medicine is by teaching facts. Teaching facts takes little thought and preparation on the part of the instructor, and facts are avidly devoured by the student as something tangible, something by which his progress in medicine can be measured. But isolated facts are learned by memorizing and there is no future to the practice of memorizing.

"Teaching by concept is more difficult: contemplation and preparation are required of the teacher. Concepts are less well enjoyed, except by the abler students, because the grasping of concepts requires reasoning. In contrast to memorizing, however, the habit of reasoning breeds growth.

"Facts have another disadvantage as a means to medical education. In the light of new evidence they do not always turn out to be as they have appeared. False facts once learned are hard to unlearn. There have been many evanescent 'facts' in surgical teaching in the past 25 years.

"Concepts, which may be defined as theoretical explanations for groups of otherwise isolated facts, are more slowly arrived at. The facts which each concept integrates will have undergone longer tests of time. Such facts are easily learned because they fit into a reasonable pattern and do not require the brute memory of the isolated fact. Since they are in essence theoretical, concepts are accepted by the student with greater hesitancy and subjected to more repeated questioning. Concepts are therefore more important than facts in medical education and the facts to be taught should be limited to those needed to illustrate concepts."

The committee pointed out that since 1900 the only change in the pattern of the medical curriculum has been the gradual increase in the number of specialty departments. The basic allotment to both pre-clinical sciences and clinical subjects has remained essentially the same. However, "the faculties of a few medical schools have already felt a need for better integration of thinking and have introduced collaborative teaching exercises both as lectures and clinics. Wherever tried, it is unanimously believed that better education results."

Qualities sought in the prospective student were listed as open-mindedness, generosity, and equanimity. "The student must be open-minded in order to be able to change as concepts develop and to grow with medicine." It was also stressed that medical education stands or falls with the teacher, and that "the broad concepts and careful education given to undergraduates should be preserved and built upon during graduate years."

The core of the recommendations given were that the trend toward separate specialty departments in undergraduate teaching should be reversed and that the deficiencies of the present curriculum will be facilitated by better integration. The report concludes with a proposed three-part totally integrated curriculum offered as one possible experiment in medical education. This was the outgrowth of a conference on medical and

dental education held under the auspices of the Markle and Rockefeller Foundations at Great Barrington in September, 1949, under the chairmanship of Dr. LeRoy A. Johnson.

Part 1. Introductory Phase: "The student is to be shown the reasons behind the requirements of courses in laboratory science (chemistry, physics, mathematics), the social sciences (economics and history) and the humanities (languages and culture). Scientific laws and concepts will be illustrated in the problems of the human being, normal and diseased. . . . Human biology is to be established. . . . Experimental animals are to be referred to only to point out the more important differences and complications of the human being, including a demonstration of the significance of the human cerebral cortex." This phase would also include bacteriology, immunology, and rudiments of psychology.

Part 2: "The second part of the curriculum is a detailed study of the organ systems of the body, both in health and disease. The normal anatomy and physiology and the effect upon them of disease would be studied together. The relation of the normal and disordered physiology of each system would be related at the end of each section to the problem of the body as a whole. The effect of the disease upon mental outlook of the patient, and upon the family and members of the community, completes the study of each system."

Part 3: "By responsible contact with the patient, the concepts and knowledge gained in Parts 1 and 2 are synthesized in Part 3. The student will act as a clinical clerk, as at present, sharing the responsibility for the care of the patient and for the working out of public health problems, whereas in Parts 1 and 2 teaching was by demonstration and precept at the bedside, supplemented by seminar discussions, reading, and samples of laboratory work. In Part 3 the student becomes an integral part of the team caring for the patient. As the student's experience increases so will his partaking share grow."

The chief advantages of this curriculum, the committee felt, were that the co-ordinated point of view would be more efficient, excluding unnecessary sampling or duplication and that "because the fields of medicine must inevitably be more and more collaborative (the group practice aspect of medicine), the co-ordinated teaching with no departmental structure should ingrain in the student the significance of collaboration."

It was thought the chief pitfalls would come in Part 1 and that the success of the curriculum would depend upon a small enough group for sufficient individual attention.

REVIEWS

As its title implies, *The Common Sense of Science* by J. Bronowski (154 pages; $2.00; Harvard University Press, 1953) is a book about the essential nature of science, the culture of science, if you will. Its author is distinguished in Britain, his adopted country, both as a scientist and as a man of letters. His specialty in mathematics is statistical analysis, and since 1950 he has been director of the Central Research Establishment of the National Coal Board. One might guess his specialty from this text alone, but certainly there is in it no clue to his present occupation.

There are several distinct, though somewhat related, theses in the tightly written, smoothly flowing chapters of this compact, meaty book. Each of them is thought-provoking and well worthy of attention. For example, Dr. Bronowski challenges the concept "that art and science are different and somehow incompatible interests." He decries "the habit of opposing the artistic to the scientific temper" and identifying them "with a creative and a critical approach." He notes that the arts and the sciences have long "been in competition for the most lively young brains" and wisely comments that "this competition is itself the clearest evidence that good minds can fulfill themselves as well in one as in the other." The apparent discordance between science and the arts is due to "the lack of a broad and general language in our culture . . . It is the business of each of us to try to remake that one universal language which alone can unite art and science, and layman and scientist, in a common understanding."

As he proceeds to justify the title of his book, Dr. Bronowski considers the "three creative ideas which, each in its turn, have been central to science. They are the idea of order, the idea of causes, and the idea of chance . . . None of these ideas is peculiar to science . . . They are common sense ideas; by which I mean that they are generalizations which we all make from our daily lives, and which we go on using to help us run our lives." The scientific view has, however, brought significant changes in our thinking about each of these ideas. "The Scientific Revolution was a change from a world of things ordered according to their ideal nature, to a world of events running in a steady mechanism of before and after."

During the 19th century scientists took cause and effect as their guiding principle and that idea has a powerful hold on our minds today. Twentieth century science, on the other hand, is replacing many of the classical "causal laws" by "statistical laws" and is putting new meaning into the idea of chance. The statistical method "depends not on unlimited accuracy in measuring a character, but on judging the accuracy by a measure of the inherent variation from individual to individual which we cannot escape." The laws of chance seem at first to be lawless, but they can be formulated with as much rigor as the laws of cause. Indeed, they "are lively, vigorous and human; and they may give us again that forward look

which in the last half century has so tragically lowered its eyes."

Turning our thought toward the future, Dr. Bronowski presents some very stimulating ideas about truth and value. Science shares the values of all human action, but human values change and in this change, science plays a creative part. "Science is a process of creating new concepts which unify our understanding of the world, and the process is today bolder and more far-reaching, more triumphant even than at the great threshold of the Scientific Revolution." Like the concepts of value, the concepts of science are "monuments to our sense of unity in nature."

In these years of our own lives, an abyss has become more apparent in the human mind: "a gulf between the endeavor to be man, and the relish in being brute . . . Science has shown in harsh relief the division between our values and our world." I cannot agree with Dr. Bronowski that "there is no cure in high moral precepts," but I am completely on his side when he concludes that science will "discover virtues, when it looks into man; when it explores what makes him man and not an animal, and what makes his societies human and not animal packs."

—*Kirtley F. Mather*

It is only occasionally that a book reviewer can, with perfect conscience, begin a review with the words, "Here is a book which marks the beginning of a chain reaction. It is *must* reading for every teacher, for everyone interested in integration, and for all those who watch for some significant change in psychology and our philosophical concepts regarding the nature of human nature." In this instance these words apply to and should all be printed in italics for *The Living Brain,* by W. Grey Walter (W. W. Norton, N. Y., 1953, 279 pp., index, biblio., 3 appendices, $3.95).

Most of us are unaware that the field of electroencephalography has developed remarkably during the last war and subsequently. This lack of awareness is greater in this country than in England for here we largely limit the use of EEG to diagnosis of brain tumors and epilepsy. In England, however, there appears to be more fundamental research. Therefore, unknown to most of us, electroencephalographic research has come a long way in the past ten years and its findings have implications far beyond their usual diagnostic limits. This readable book (English scientists do seem to have a way of writing that is a joy to the reader) brings us up to date and introduces concepts which have extreme importance.

The electroencephalograph itself has been improved by application of some of the newer electronic techniques. Wave analyzers are now used to decode complex brain wave patterns. The stroboscope has been used to produce flicker on the optic areas with startling results. In this connection, too, there is a long discussion of simple machines which rove, move about, and learn like animals.

Since the work of Dr. Harmon on vision, remedial reading teachers and others have abandoned the concept that the eye is a camera. To those thus prepared with the concept that the eye scans in much the same way as a television iconoscope, it should not come as a surprise to learn that the living brain scans for significance among the sense data supplied it by the organs of sense. ". . . it has been suggested that the more regular familiar rhythms represent a process of hunting for information. They are the repeated asking of a question; their rhythmicity is a sign of perpetual quest, their arrest the mark of its ending. It is in periods when rhythmic activity is minimal that we should expect the closest correspondence to mental states – and so indeed it turns out."

Granting that the brain scans, one may question, what is it seeking? "What the nervous system receives from the sense organs is information about differences – about the ratios between stimuli," says the author, who then proceeds to elaborate upon brain function as a searching for patterns of significance and for the significance of patterns. While this may sound like an adaptation of gestalt psychology, the physiological findings relate also to conditioning and to learning by association. The results are that ". . . Clearly, before an association can mature, there must be a device to sort out and select incoming signals on the basis of the order in which they occur and the regularity of their coincidence . . . there is plainly statistical analysis . . ." ["an operation which can determine whether a new signal is worth bothering about"]. "What we are suggesting is that the brain must, quietly, unobtrusively, incessantly, reckon [as does a bookmaker] the odds in favor of one set of events implying another."

A detailed study of learning (a seven-step process is carefully outlined with a possible eighth step), association, and memory is given. Here the author indicates where the behaviorists got off the track with Pavlov and shows the importance of his discussion of toys that can learn.

As one would expect, EEG research demonstrates that the brain acts as a whole and that even the special projection areas of the senses are "more like leaseholds than ownership." But what is extremely important also is the conclusion that "in the brain . . . idiosyncrasy is the rule and equality a myth. The brain is essentially the organ of personality." Also of immediate importance is the statement that "intelligence as estimated by arbitrary and already obsolescent tests, finds no parallel in our tracings; but versatility, ductility, and certain special imaginative aptitudes are beginning to be recognized as dynamic interrelations and transformations within the framework of normal variation. Note that the classes so adumbrated are not based on what a person can or cannot do, but on *ways* of doing things."

"The practical consequences of physiological infiltration into philosophical domains," says the author, "will be only as serious as the community cares to make them. But it may be assumed that no mental theory or practice is likely to survive which does not take into account the principles of cerebral functions revealed by physiology any more than the practice of medicine can ignore other physical functions." And this reviewer finds himself inclined to go on at length with quotable quotes from the author's provocative statements about radio, television, organized sports, play, overcrowding in schools, and the role of the teacher.

Let it suffice, in conclusion, therefore, to indicate how this volume touches upon integrated education. Obviously, if the brain scans for significant relationships, significance is given to impressions by concepts

and interrelationships are integrations. Dr. Walter says, "Continuation of the sectarian process of specialization could only lead to one result, the creation of an irresponsible scientific priesthood, preoccupied entirely with its liturgy and its mysteries; and, in due course, to a popular revulsion from scientific knowledge and a slump in scientific credit that would usher in a dark age as vicious and prolonged as the aftermath of an atomic war.

"The root of the evil is that facts accumulate at a far higher rate than does the understanding of them. Rational thought depends literally on ratio, on the proportions and relations between things. . . . As facts are collected, the number of possibilities between them increases at an enormous rate . . . The extreme specialization and segregation of the present epoch is a novelty in human affairs. If left unmitigated, it could spell ruin." (Here he indicates the importance of electronic brains as taking the load from the overburdened brain as to sorting out details.) "But the future of the brain is more intriguing than a mere holiday from drudgery, for it is only when the servants of thought have done their work and retired unobtrusively to their quarters that the master brain can discover its own place and settle down at last to its proper work." *H.W.C.*

In this age when over-specialization in biology has tended to keep the various fields so separate, it is most heartening to discover *Microbiology and Human Progress* by Madeleine Parker Grant (Rinehart and Co., New York, 1953, $6.75, 718 pp., index). The book succeeds in fulfilling the author's objective of presenting the cultural aspects of microbiology "so that the student may become aware of the interdependence of science and society." Dr. Grant considers the bacteriological details "against a background of broad biological concepts," emphasizes "the effects of microorganisms on the life and death of man," and attempts to present sufficient discussion of the human body "so that the reader need not turn to other sources for necessary information. It is intended, therefore, that sections of this book shall also serve as appropriate material for basic courses in general and human biology."

In the introductory chapter to Part I, which deals with the biology of microorganisms, we are advised that "the study of microbes need not result in a highly specialized adventure, for, although microbic forms represent a particular group of organisms, they actually offer rich opportunity for understanding many basic biological principles . . . The student of biology who studies the evidence for organic evolution through geologic time gains a sense of progress through change that is an important concept in all contemporary thought . . . It is important to emphasize that man emotionally resists the idea of change. He actually fears it . . . Studies in science not only can help us to conquer a fear of change but can actually bring us to value it, and possibly even to find security in a social philosophy that recognizes change to be inevitable and potentially good."

"Science is fundamentally a way of thinking, and its methods need not, in fact, should not, be confined to laboratory experiments . . . Laboratory inquiries lend themselves to scientific analysis; yet the study of how this method, with whatever modifications may be necessary, can be applied to vital personal, national, and international problems is the enduring challenge to those who wish to form habits of critical thinking and effective action. This requires that the student, in and out of the laboratory, learn to use his own eyes, to trust his own observations, and to acknowledge and act on the truth, whatever it may reveal."

The next three hundred pages give the basic facts and techniques of microbiology: history, cultivation and destruction of microorganisms, growth characteristics and heredity, etc. The book is rich with pertinent illustrations and tables, clear explanations and descriptions.

The author's rare understanding is constantly present in the discussions. "In tracing the growth of the scientific interpretation of life we see an integration of the natural sciences. Chemists, physicists, and biologists meet in their attempts to understand life processes . . . The field of biology receives daily contributions from the older sciences of physics and chemistry. But the biologist urges us not to forget that the organization within the cell, which makes these chemical reactions possible, has not yet been explained . . . Many biologists take the point of view of the gestalt psychologists when they remind us that the organism as a whole is *something else* than the addition of its physical-chemical phenomena. Until a basic principle explaining the organization of matter within the living cell can be formulated, the fundamental chemical characteristics of life must remain unknown. In calling attention to this aspect of the problem, let us emphasize that the modern biologist does not regard this 'something else,' which we frequently referred to as its organization, as unknowable."

In a chapter on the social characteristics of microorganisms Dr. Grant reminds us that "the idea of an optimum-population group, established through the joint action of antagonism and cooperation, gives us reason to believe that even in competition there are sometimes elements of cooperation. Such ideas make it possible to postulate an inherent tendency toward groupness, toward cooperation, that runs through protoplasm itself. We may visualize two inseparable processes that operate in organic evolution: the evolution of the individual, seen with the formation of the species showing increasing complexities, and the evolution of sociality, with increasing complexities of social mechanisms."

Part II presents the microbic friends of man, those essential to the life of man such as the organisms capable of fixing nitrogen from the atmosphere to increase soil fertility, and those beneficial to man such as the organisms used in the manufacture of cheese.

Part III deals with the microbic foes of man from two points of view, the biological aspects of infectious disease (health, resistance and immunity), and a detailed discussion of the important infectious diseases grouped according to the portals of entry of the germs into the human body.

The final chapters, "Microbiology and War" and "Beyond the Microscope," furnish a most adequate conclusion to this ambitious book. "If we measure biological progress as an increasing freedom from control by the environment that organisms reveal, then it becomes clear that organic evolution does exhibit progressive change. For example, the emergence of

warm-blooded animals having a four-chambered heart and nerve mechanisms for control of a constant body temperature achieved a way of life with greater freedom from the environment than is possible for organisms without these structures. Further progress is also noted with increasing development of the nervous system, which not only emancipates organisms from restricted environments, but actually makes it possible for the human species to exert an ever-increasing control over natural forces."

"The quest for evidence of an unfolding purpose in the pattern of organic evolution is less easily satisfied. Biology does not picture nature as working for preordained ends; yet man, a purposeful being, is the product of evolution. He is endowed with consciousness of self and the universe. He asks questions of his own experiences, and for satisfying answers to many of these he must wait with a quality we call faith. When he is sufficiently modest, he is like the experimental scientist with his hypothesis, believing in it but ready to surrender it when a new truth has been discovered."—*Ruth Lofgren*

Interest in the causes which lead to the development of peaks of society is now lively and general. The hope is that a proper understanding of the essential unity of arts, sciences, philosophies, sports, and economic and social criteria may show us how societies use a previous integrated outlook to achieve such a height. This may be, granted always that there is enough peace abroad to permit an expression of the unity to appear in its institutions, its buildings, and its total way of life. *Ideas and Men, the Story of Western Thought,* by Crane Brinton, MacLean Professor of Ancient and Modern History at Harvard, provides a compact but provocative initial source for a part of such a study. We are noticing it in its recent reprinting by Prentice-Hall (New York, 1951, 550 pages, plus 21 pages of valuable bibliography and an index, $6).

The teacher who may use it is warned by the author himself as to the inadequacy of this work (p. 529): "For the historian of the clusters of ideas about the Big Questions which have prevailed hitherto in the West, it is hardly necessary to devote much attention to other cultures than the Western." We are grateful for this admission, but we must beg to disagree flatly with Professor Brinton. In fact, he himself seems to believe that Europe's apparent isolation is now possibly ended, along with her superficial dominance.

"It is quite possible that this spiritual self-sufficiency of the West may be changing, and that in the next century or so there will arise in the West and indeed all over the world a great syncretic religion and philosophy into which will pour the long wisdom of the East" (page 530)

It is a pity that so gifted a writer should have said virtually nothing about the Indo-European origins of European language and culture. We feel that, failing this, he could at least have pointed out clearly in his survey that what destroyed inherited European cosmology and hence European integration was an Eastern importation, Hindu mathematics; and that what made European integration possible and its doom certain was its isolation from the world context, compelling Europeans to use a restricted cultural resource. Furthermore, he contradicts his own argument as to the central role of cosmology in the integration of a society when he says on page 530: "Even the most high-minded of cosmopolitans should not shut from his mind the possibility that the rest of the world may in the next few generations be won over at least to Western material wants, and that the Ford, air-conditioning, and the comic strip may conquer both Confucius and Buddha."

This is, of course, nonsense, judged even by the author's hinted thesis. Even if Ford cars, air-conditioning, and the comic strip are not ruining the West with homicide, smoke-cloaked suburban trains, and meretricious rubbish much faster than they are likely to possess the East, nevertheless, on the long haul, good cosmologies win an allegiance which clever technologies can never command. Professor Brinton is aware of this. That is the merit of this work. Its chief deficiency is its shortness of historic scope.

F.L.K.

The Study of Human Nature, by David Lindsay Watson (Antioch Press, Yellow Springs, Ohio, 1953, 255 pages and index, $3.50) is a group of essays by a Scottish physical chemist who taught and practiced his profession in the United States for twenty-seven years. He is not to be counted among those whose reaction to our ignorance in biology, psychology, and sociology is like that of Thoreau: to live with nature, and especially human nature, and thus experience directly; or like that of J. B. Watson, to accept our ignorance and become a behaviorist. All this is essentially defeatism. These essays indicate that the response to the notorious unbalance in our knowledge is not less but more and better balanced learning. The author agrees and indeed has practiced the principle that each one of us should retreat to nature now and then; but he does not let us assume that our small, direct, private experience constitutes anything but a feeble substitute for the public knowledge we need. This is what makes this book notable. For every such defeat means less resource for genuine research in those domains that must be opened up to equalize the pressure of physics upon us.

Dr. Watson is first concerned with the need to ensure that the student comes alive and lives and is made aware of our deficiencies in sociology and psychology, in particular. Second, he urges eloquently the right use of intuition for emergency relief, and the development of the emotions: ". . . what we seek is a condition of the soul." (page 146) After that the social sciences can grow.

A valuable work! It offers no prescription for the solution of the morphological and psychological problem, but it will awaken the teacher and it will deepen his hope, provided he is not put off by what he may take to be religiosity in the second quarter of the volume.

The Russell Sage Foundation, New York, has issued the report on *Elementary School Objectives* prepared by Nolan C. Kearney for the Mid-Century Committee on Outcomes in Elementary Education (1953, 181 pages and index, $3).

This constitutes a useful summary of recommended goals at primary, intermediate, and upper grade ages in respect to physical, social, and emotional development, ethics, social relations, and a few more categories. Considering training chiefly, the teacher will

find much guidance. But in respect to understanding, the survey falls short, and operates at a descriptive level. For example, the section on Ethical Behavior, Standards, Values (pp. 68-73) starts out: "Ethical behavior, standards, and values are related to the observance of the moral and the civil law." There is nothing in the passage which follows to show that moral and civil law rests upon natural law. Thus, at the start, the divergence of scientific learning (which is all the time lying in wait for the child) and mores is left unnoticed.

May we be permitted to remark that if the Russell Sage Foundation were to conduct a study as to *how we can reach* these recommended goals, it would be contributing signally to our welfare?

In 1932 appeared a work by David Hilbert (and S. Cohn-Vossen) so rare in its field as to be very nearly unique. *Anschauliche Geometrie* was, in respect to pure geometry, what D'Arcy Thompson's celebrated work, *On Growth and Form,* was and is to the geometry and number of living orders.

This work of Hilbert's has now been made accessible in English under the title *Geometry and the Imagination,* the translator being P. Nemenyi (Chelsea Publishing Company, New York, 1952, $6.00).

As the title indicates, geometry is the main theme. As readers of the original text know, the author aimed to supply in visual form all the essential items that can be thus treated, and so to keep number and algebraic theory at a minimum. There are 330 figures, and with their aid the general reader can find his way through the 342 pages. The index is excellent. The book is a classic, and the translator and publisher are to be thanked for giving it so admirable a form. Chelsea publishes the three volume *History of the Theory of Numbers,* edited by L. E. Dickson and approximately a hundred other mathematical works of first rank importance, mostly in German. It is to be hoped that more and more of those, indispensable to the perception and teaching of the foundations common to all mathematics, will be issued in English for purposes of integrative education. Popular books on mathematics, such as the admirable *Mathematics and the Imagination,* by Edward Kasner and James Newman (Simon and Schuster, New York, 1952) serve to intrigue the mind. But in our times we need to get down to the foundations upon which the mind rests, if the mind is to be brought to rest, so that it can reflect whatever it is that a quiet mind and ordered emotions are designed to mirror. Excitement without incitement is ruinous.

As an example of the beauty of this work we reproduce on the cover of this issue of MAIN CURRENTS without explanation — for a proper account would run to volumes — figure 172, page 152, of one of the possible solid-entry three dimensional models of the 24-cell regular convex polytopes. This, with its self-dual (or self-reciprocal) figure constitutes the last unit possible in the series of regular convex polygons, polyhedra, and (in four dimensions) polytopes of Euclidian space.—*F.L.K.*

NEWS AND NOTES

Integration in England

In June, Harvey W. Culp, Administrative Officer of the Foundation, had a luncheon conference with Sir Walter Moberly in his apartment in Windsor Castle. Sir Walter is particularly interested in our courses in adult education, since his own work (in Cumberland Lodge, the Royal Park, Windsor) is at present largely devoted to seminars and discussion groups among professional and lay adults. Discussions are on central topics, particularly those having moral and ethical connotations, which relate to all disciplines but are the specialty of none. In the future, we hope there may develop a closer collaboration between this work and our own.

Unesco

Mr. Culp also spent considerable time with Dr. Gerald Wendt and others at the Paris headquarters of Unesco in June. Here the work and the program of the Foundation were keenly examined as potentially a powerful tool in the solution of many of the knotty problems with which Unesco is wrestling in every corner of the globe.

The approach which this Foundation offers — emphasis upon concepts rather than upon facts — was appealing. This was especially true when it was stressed by Mr. Culp that the emphasis upon concepts is not emphasis upon a new dogma. Rather, it was a rightful recognition of the truth that the concepts of a given time are the accumulated fruits of a universal human resource, conceptualizing. As men make a common cause, new and more valid concepts must be expected to arise to replace old dogmas. World education on any other basis can only serve to produce frictions between the possessors of facts which must be arbitrated. Only conceptual education can restore to men their position as participants in the enormous process of creating and testing concepts.

As a result of these conferences it is probable that the Foundation for Integrated Education and Unesco will collaborate in the 1955 session of the

Rencontres de Geneve (an annual international workshop lasting about 10 days) in Geneva, Switzerland, on the topic of the application of integrated (conceptual) education to the educational systems of the countries and the cultures of the world.

American participation in the Rencontres has been slight to date, largely because of the expense of transatlantic travel. American participation is sorely needed.

In Unesco, as in his contacts with many others in educational circles and in various posts of our Department of State, Mr. Culp heard repeated expressions that, more important than political, military, and economic forces, the great need of the world was *ideas.*

Henry Margenau, who has been a visiting professor at Heidelberg, and Kirtley F. Mather, who has just returned from Europe, have also discussed the work of the Foundation with Dr. Wendt and others at Unesco.

We are much impressed by the approach of Unesco to the complicated problems with which it must deal. With unusual insight and sensitivity for the numerous human factors and feelings which make even the elementary educational and cultural project a difficult one, it would seem that many who are associated with Unesco are exhibiting an unusual breadth of vision. Typical of this is the expression of I. Bernard Cohen in an article, "The Education of the Public in Science," *Impact of Science on Society,* Vol. III, No. 2. We quote excerpts below:

"The world will not, we trust, live forever on a military economy. A fundamental problem for society, therefore, is whether it will continue, during the peace that we envisage in the future, to support scientific research of every sort on the scale which has become normal during the present period of tension. It is easy enough to make out a case for peacetime support of so-called medical research. So long as cancer is the scourge of mankind, no one will doubt the value of expending whatever sums may be necessary for research into problems of growth and others that seem related to the cancer question. Nor would anyone hesitate for a moment to encourage research directly related to making agriculture more productive, to lengthening the span of life of human beings and animals, and so on.

"But where shall we find justification for the construction of giant observatories which seek out distant stars, galaxies, and globular clusters which are so very far away from us that the light by which we study them takes millions of millions of years to arrive at the earth? . . . The world needs more housing, more clothing, more food—how can we justify the satisfaction of what must seem to the uneducated an idle curiosity about what is going on in the great beyond, while the practical needs of man loom so strongly before us?

"The foregoing example — extreme as it is — will show how dangerous for the progress of science is a simple equation of scientific research with practical affairs and a plea for the support of science based on its immediate usefulness alone. In other words, however much we may esteem (or even, in some cases, regret) the vast applications of science, we must not — if we wish the scientific enterprise to continue — plead for its support solely on the basis of the immediate tangible by-products . . . there are values in science, apart from practical applications, that fully merit public support and esteem . . .

"Since General Education in science is conceived primarily in terms of the need of the nonscientist, the aims of the courses and even the details of their design must reflect the reasons why we ask that all students study science. If we do not believe that students will learn *the* scientific method and then be able to apply it to every aspect of living, why do we demand some study of science from men and women whose primary interests lie in such fields as literature, fine arts, history, government, economics, philosophy, or sociology, and whose livelihood will be earned in pursuits that do not call for scientific knowledge? . . . Part of education consists in becoming acquainted with the great achievements of man cultural and material. Science is plainly one of the major creations of the human spirit and ranks with philosophy, of which it was once a part, as a product of contemplating and investigating the 'big questions' of human existence and the universe. As a subject that has occupied the best minds engaged in creative activity over the centuries, without science a study of civilization is incomplete . . . science has affected the material side of civilization as well as having been a creative force in its own right and in its influence at various times on literature, the fine arts, and even religious, political, and social thought. Hence, to be ignorant of science is to be ignorant.

"Furthermore, our lives are affected today by science in more than a purely material sense. Science endows us with an understanding of the world around us that affords a delight to the mind, showing the interaction of the data of common experience, the enlarged vision obtained through the use of scientific instruments, the application of logic and the creative imagination. Science not only makes possible control of our environment, but enables us to predict, and thus be prepared for, events that we cannot control, such as storms and astronomical phenomena. A recognition of the cyclic repetition of natural events, and the causal explanation of them, removes the terrors that had previously accompanied the appearance of comets, eclipses, and even plagues . . ."

The Seventh Annual Workshop

The Foundation's Seventh Annual Workshop (June 28th-July 2nd), was cosponsored by the University of Maine. The roster of participants showed representatives from 25 colleges, in addition to secondary school teachers, and professional men and women. A large number of faculty from the University of Maine attended the sessions, bringing the full workshop group to about 75.

Professor Pitirim A. Sorokin of Harvard opened the workshop with a discussion on the role of creativity in science and other fields. Professor Robert Lindsay, head of the Physics Department at Brown University, led off on Monday morning with a description of theoretical thinking in physics, which was followed by a panel discussion (Professors Clark and Combellack of Colby and Kimball of Maine) on the place of logic and mathematics in the current transition toward creativity in science. That evening saw one of the high spots of the conference in Dr. Clarence Cook Little's talk on frontier work in "Genetics and Morphology." Dr. Little described conclusions from his work at the Roscoe B. Jackson Memorial Laboratory at Bar Harbor. On Tuesday morning, Professor Norman Munn spoke on creativity in psychology, outlining the main schools taught on most campuses. Professor Peter Bertocci presented his view of creativity in science and in art: science as impersonal, objective, seeking law; art as the reflection of the artist as a person, displaying the universal in the individual, the particular. That evening Professors Charles Virtue and Cecil Reynolds of the University of Maine interpreted the various levels of meaning at which creativity can be seen in literature and in the arts.

Wednesday was devoted to education and the role of integration. Professor Robert Ulich of Harvard stressed the teacher as a major integrating force. (His lecture appears on pages 3-7 of this issue.) Dr. Herbert Espy, Commissioner of Education of the State of Maine, spoke on the urgent needs of secondary schools. That evening Mr. F. L. Kunz of the Foundation portrayed the role of India in world affairs, and outlined that country's ancient philosophies. On Thursday, Professor John Q. Stewart of Princeton told the participants of his concept of social physics, and the use of the deductive method in this field.

F. L. Kunz is now on the West Coast, where a cross country tour of colleges and universities has taken him. He visited a few colleges on the way out, among them Washington State at Pullman.

The course in Philadelphia, which was so successful last season, will be repeated next year. The general outline of "The Frontier of Knowledge" will be preserved but the first lecture and the four summary seminars will focus on the process by which a human being "knows" or "learns" anything. The importance of concepts and of the process of conceptualizing will, it is hoped, thus be kept to the fore. The course will run for thirty weeks beginning October 7.

Under the sponsorship of the Staten Island Museum of Arts and Sciences, a series of five lectures will be given this year. The lectures will be given on alternate Tuesdays beginning October 6 when Dr. Gardner Murphy will open the series with his lecture on "The Nature of Man." Other lectures will be given by Dr. Clyde Kluckhohn, Dr. John Q. Stewart, Dr. Harold Rugg, and Mr. F. L. Kunz. This series arises out of the successful presentation of three lectures under the same sponsorship last season.

Under the editorship of Dr. Delmer Goode and a committee of the faculty of Oregon State College, a new journal, *Improving College and University Teaching*, has made its appearance (issued February, May and November, The Graduate School of Oregon State College, Corvallis, Oregon, $1.50 a year). It is of interest that the editorial committee includes the Deans of Engineering and of Education, which may be taken as further evidence that everywhere scientists and engineers are as concerned about the decay of ethics and civil courage as are professional educators.

From an article by Dr. George W. Gleeson, Dean of Engineering, entitled, "The Student's Background and College Teaching," in Vol. I, No. 2 of this new journal we quote several sentences which the author italicizes:

"Students are permitted to attempt to run before they have learned to walk.

"Facts of themselves are not important.

"Concepts need to be considered in their entirety.

"It is not as important that a student be proficient in something as it is that he be proficient *with* something.

"A student learns only from what he does and from all that he does.

"Early advisement regarding the requirements of professional fields is essential.

"Facility with modes of communication is essential.

"Evasion or substitution activities cannot replace requisite study patterns in preparation for professional careers.

"As in all fields, ethics, honesty, and morality cannot be divorced from professional competence.

"Subjects and procedures associated with science should be included in science teaching."

We also quote in its entirety his paragraph about concepts:

"Unless a basic concept of science can be considered in its entirety and in relationship to associated concepts, then it were better not taught. A fragmented concept of science is a half truth. Half truths result in half right thinking. The more fragmented the concept the more handicapped the student. Likewise, an isolated concept, even taught in its entirety, but unrelated to associated concepts, may have negative rather than positive value. The foregoing statement is perhaps more applicable to simpler concepts than to the more complex, and is accordingly a matter of concern in secondary education. Perhaps an example is called for.

"For many years one of the questions on a pretest had been, 'What is work?' Where the question is answered at all, the answer is always the same: force x distance. Never in ten long years has any student deviated and answered with pressure x volume, or torque x angle, or temperature x entropy, or any of the other products which might define work. Seldom do students equate work and energy and, of course, never do they present a comprehensive or concise definition. Their background instruction has limited their capacity for thinking about such a simple concept as work to one very specific and also limited example. Many students find it difficult to expand their thinking once they have assimilated a partial concept."

We feel that it is proper to ask the question: Where in the modern college or graduate school does the student study concepts in their entirety? Dean Gleeson is professionally concerned with concepts in science. But there are many areas of experience where science is, at present, so poorly organized that other means than measurement and simple observation have to be brought into use. Can it be held that the student is to devise his own general concepts, unaided, if not impeded, by teachers? Modern thought calls for a modern cosmology, a description of man's place in the universe.

It is silly and dangerous to preach the gospel of the individual uniqueness and worth of a student when the student has been given no facilities to find out how and why his life counts in the thousands or millions of island universes that have been going on for thousands of millions of years. We agree heartily with Dean Gleeson: "As in all fields, ethics, honesty, and morality cannot be divorced from professional competence." It is notable that this is the only one of his italicized sentences which the author does not explain by a paragraph. Shall ethics be plastered over the student's mind, or are they integral to his intellectual experience? What shall be done to relate the notions of science about an ordered universe to the notions about a divine presence which the student might have heard of at home or in his church or temple? The answers to these questions might be made by the student himself if he were to be taught somewhere in college the over-all concepts required by modern and valid inherited experience. No one would ask a Dean of Engineering to do this job; but are we not entitled to ask the College to do it?